CLAIMS

1. A film deposition apparatus (2) for depositing a film on an object (W) to be processed, the film deposition apparatus (2) comprising:

a process chamber (4) accommodating the object (W) therein;

process gas supplying means (74, 78, 80, 68A-68C, 82, 70A-70C) for supplying process gases including a raw material gas and an oxidant gas;

evacuating means (10-14) for evacuating the process gases from said process chamber (4) so as to maintain said process chamber (4) to be at a predetermined vacuum; and

process gas introducing means (50) for introducing the process gases supplied from said process gas supplying means into said process chamber (4),

wherein said process gas introducing means (50) is configured and arranged to inject the process gases toward an entire surface of the object (W), a gas injecting surface from which the process gases are injected being divided into an inner zone (84) covering a center portion of the object (W) and an outer zone (86) surrounding the inner zone (84); and

said process gas supplying means (74, 78, 80, 68A-68C, 82, 70A-70C) selectively supplies the process gases to said process gas introducing means (50) so that the raw material gas is separately injected from said inner zone (84) and said outer zone (86) and the oxidant gas is separately injected from said inner zone (84) and said outer zone (86).

2. The film deposition apparatus as claimed in

claim 1, wherein said process gas supplying means includes switching means (67A-67D, 90) for switching the supply of the raw material gas to said process gas introducing means (50) so that the raw material gas is selectively injected from either said inner zone (84) alone or both said inner zone (84) and said outer zone (86), and the oxidant gas is selectively injected from either said outer zone (86) alone or both said inner zone (84) and said outer zone (86).

3. The film deposition apparatus as claimed in claim 2, wherein said process gas supplying means includes a first raw material gas supply passage (62) supplying the raw material gas to said inner zone (84), a second raw material gas supply passage (66) supplying the raw material gas to said outer zone (84), a first oxidant gas supply passage (74) supplying the oxidant gas to said inner zone (84) and a second oxidant gas supply passage (78) supplying the oxidant gas to said outer zone (86); and

said switching means includes a first open/close valve (67A) provided to said first raw material gas supply passage (62), a second open/close valve (67B) provided to said second raw material gas passage (66), a third open/close valve (67C) provided to said first oxidant gas supplying passage (74) and a fourth open/close valve provided to said second oxidant gas supply passage (78).

4. The film deposition apparatus as claimed in claim 1, wherein the raw material gas is a mixture of a plurality of material gases, and said process gas supplying means includes:

a plurality of material gas supplying passages

(68A-68C); and

an open/close valve (67E) provided to one of said material gas supplying passages (68A-68C) so that the material gas supplied through said one of said material gas supplying passages (68A-68C) is selectively added to the raw material gas.

5. The film deposition apparatus as claimed in claim 1, wherein said process chamber (4) includes:

a table (18) on which the object (W) is placed; and

a vertical moving mechanism (162) for moving said table (18) in a vertical direction so that a distance between said table and said process gas introducing means (50) is changeable.

6. The film deposition apparatus as claimed in claim 1, further comprising:

pressure detecting means (92A-92D) for detecting a pressure of each of the raw material gas and the oxidant gas in said process gas introducing means;

dilution gas adding means (96, 98, 100, 102) for adding a dilution gas to one of the raw material gas and the oxidant gas; and

dilution gas amount control means (94) for controlling an amount of the dilution gas to be added based on the pressure detected by said pressure detecting means (92A-92D) so that the pressures of the raw material gas and the oxidant gas in said process gas introducing means are substantially equal to each other.

7. The film deposition apparatus as claimed in claim 3, wherein said process gas introducing means

comprises a showerhead (50) having a plurality of raw material gas injection openings (52) and a plurality of oxidant gas injection openings (54) uniformly arranged on a bottom surface thereof, said bottom surface corresponding to said gas injection surface divided into said inner zone (84) and said outer zone (86), said showerhead (50) includes:

an inner raw material gas head space (56A) connected to said first raw material gas supply passage (62), a part of said injection openings (52A) located in said inner zone (84) being connected to said inner raw material head space (56A);

an outer raw material gas head space (56B) connected to said second raw material gas supply passage (66), a part of said injection openings (52B) located in said outer zone (86) being connected to said outer raw material head space (56B);

an inner oxidant gas head space (58A) connected to said first oxidant gas supply passage (74), a part of said injection openings (54A) located in said inner zone (84) being connected to said inner oxidant gas head space (58A); and

an outer oxidant gas head space (58B) connected to said second oxidant gas supply passage (78), a part of said injection openings (54B) located in said outer zone (86) being connected to said outer oxidant gas head space (58B).

8. A film deposition method for forming a film on an object (W) in a process chamber (4) by introducing a raw material gas and an oxidant gas from a showerhead to said process chamber 4, the film deposition method comprising:

a first process of injecting a raw material gas to a first area directly above a center portion of the object (W) and an oxidant gas to a second area directly above a peripheral portion of the object (W) surrounding said center portion while maintaining the process chamber (4) at a first predetermined vacuum; and

a second process of injecting the raw material gas and the oxidant gas while maintaining the process chamber (4) at a second predetermined vacuum lower than the first predetermined vacuum.

9. The film deposition method as claimed in claim 8, wherein, in the second process, the raw material gas and the oxidant gas are uniformly injected to both said first area and said second area.

10. The film deposition method as claimed in claim 8, further comprising vertically moving the object (W) in said process chamber (4) so that a distance between said showerhead and the object (W) is changed between the first process and the second process.

11. The film deposition method as claimed in claim 10, wherein said distance in the first process is set to be greater than said distance in the second process.

12. The film deposition method as claimed in claim 8, wherein the first and second processes includes detecting a pressure of each of the raw material gas and the oxidant gas, and adding a dilution gas to one of the raw material gas and the oxidant gas whichever has a higher pressure than the other so as to substantially equalize the pressures of the raw material gas and the

oxidant gas.

13. The film deposition method as claimed in claim 9, wherein the raw material gas supplied in the second process is an organometallic mixture gas containing $Pb(DPM)_2$, at least one of $Zr(t\text{-}OC_4H_9)_4$, $Zr(DPM)_4$, $Zr(I\text{-}OC_3H_7)_4$, $Zr(C_5H_7O_2)_4$ and $Zr(C_5HF_6O_2)_4$ and at least one of $Ti(i\text{-}OC_3H_7)_4$ and $Ti(i\text{-}OC_3H_7)_2(DPM)_2$; the raw material gas in the first process is the organometallic mixture gas lacking the Zr material gas; and the oxidant gas supplied in the first and second processes is at least one selected from a group consisting of NO_2, O_2, O_3 and N_2O.

14. The film deposition method as claimed in claim 13, wherein the first predetermined vacuum is equal to or lower than 100 mTorr, and the second predetermined vacuum is higher than 100 mTorr.